

Chapter 1: Golf Course Design & Construction Best Management Practices

DRAFT

An outstanding golf course is the result of excellent design, responsible and phased construction, proper vegetative measures, and well thought-out course operations and maintenance.

Following proper course design and construction practices will pay big dividends in the future through reduced maintenance. Proper water management, preservation of good soil quality, and wise tee & green siting will reduce stresses on plants such as disease and negative moisture balance.

It should be kept in mind that the differences between the physiographic regions of the state including soil, topography, hydrology and climate will impact construction and management practices to be employed, as well as the siting of the golf course.



Site Selection

The first step toward establishing an environmentally compatible golf course is site selection. Normally, a course will transform between 120-200 acres of what is existing cropland, meadow, water, wetland, and woodland. This land in its existing state usually provides a great many natural resource benefits including wildlife habitat, stormwater infiltration, and scenic vistas. A thorough analysis of all natural, social, and archaeological resources of potential golf course sites should be performed. The presence and extent of some types of ecosystems may render portions or entire sites unsuitable for development. Examples include:

- Sensitive aquatic regimes
- Threatened and endangered plants or animals
- Wetlands or high water table
- Steep slopes

There may be opportunities to restore or enhance environmentally sensitive ecosystems in the golf course development process through widening of riparian buffers and establishing 'no-impact' zones of existing native vegetation. If the course is designed properly, these sensitive areas often provide some of the most distinctive integral features and scenery on a site.

Previously degraded sites such as quarries or landfills can be rehabilitated to become positive community assets after converting for golf course development.

The concept of having the golf course 'lay lightly on the land' is one that has been in use in Scotland and England for centuries. Simply put, the course designer finds a socially and environmentally suitable site and then fits the golf course to the existing terrain as much as possible. The course then is constructed in an efficient manner and proper relationships with site resources are established. Extra sensitivity is afforded the zones associated with watercourses, wetlands, and steep terrain. Much native vegetation is

preserved in large sections of rough and out-of-play areas, with intensively managed turf kept to the minimum.

In the United States, the contrary idea has been used for much of this century. That is, sculpting the golf course from the land through extensive earth moving, without sufficient regard for natural features and limitations. In this way, greater risk for environmental degradation can result, and greater management measures are necessary. This type of development can also increase costs for permitting, construction, and maintenance. Fortunately, the current school of thought in the U.S. is swinging back toward the more site-sensitive design.

A team of experienced professionals should be assembled to carry out the design, construction, and operations phases. An experienced golf course architect should be employed along with the course supervisor and typical engineering, contracting, and environmental consultants.

Communication with local residents and government officials should occur right at the inception of the project. The course should be sited and designed employing a spirit of partnership with owner, operator, designer, and local people. This is an important facet of all phases of golf course development: design, construction, and operations. Each potential site will possess both unique natural and social characteristics and should be addressed that way.



Design Components & Considerations

The following factors need to be identified and mapped as appropriate:

- Property boundaries
- Topography with areas of steep slopes emphasized
- Natural runoff patterns
- Existing vegetation
- The existing ecosystems must be identified.
- Water resources, both surface and ground, including wetlands
- Soil map units from USDA Cooperative Soil Survey
- Climatic: sun, wind orientation
- Location of underground utilities and any rights-of-way
- Scenic views for preservation
- Historical and archaeological resources
- Location and extent of threatened

- and endangered plant & wildlife habitats
- All existing roads and structures on and adjacent to the site
- Adjacent land uses

Terrain and Water Considerations

A careful study of areas such as streams, wetlands, fragile ecosystems, and unique habitats will determine their effect on the golf course. The natural drainage patterns are reviewed in conjunction with the topography. The layout must be done with respect to existing runoff patterns to provide reduced pollution risk and efficient operation and maintenance.

If the course is being constructed on existing cropland, runoff may be slightly less once the course is established; if built in woods, runoff will increase. Whenever possible, existing water features should not be altered, riparian buffers should be preserved or enhanced, and stream crossings kept at a minimum. When stream crossings do occur, they should traverse the riparian zone at a perpendicular to the stream. Existing surface water features can be utilized in the strategy of the golf course and provide for some of the most challenging and scenic golf holes.

Water features are usually added in order to improve the course and to provide improved stormwater management and water quality benefits. Stormwater retention structures such as ponds, wetlands, and enhanced grass swales or shallow ditches with 'pocket' wetlands can improve the quality of the runoff leaving the golf course. These features will be used to filter stormwater runoff from the golf course and to prevent fertilizer and pesticides from entering adjacent water resources.

Stormwater Management

Basically, three different approaches exist for stormwater management. They are detention, filtration, and infiltration. Usually, the best approach is a combination of these three. Some practices which fit into these categories are described in [Appendix 1](#).

The stormwater management scheme would be constructed in the first phases of the project.

Detention on a golf course would be accomplished through constructed detention basins, ponds and pond-wetland systems. Detention mostly controls water *quantity*, with water quality improvement usually an ancillary benefit.

Filtration would be done using constructed wetlands, biofiltration areas, sand filters, riparian forest buffers, and vegetative filter strips.

Infiltration may be accomplished with infiltration trenches, infiltration wetland basins, and biofiltration areas.

All of these stormwater management structures will need to be maintained on a regular basis in order to function properly. Accumulated debris in basins, erosion on shorelines or in swales must be addressed promptly or the structures can become offsite pollutant *exporters*.

(*Preceding adapted from: Greening Your B.C. Golf Course, Fraser River, Environment Canada British Columbia, 1996*)

Constructed water features can also be designed to provide habitat for locally indigenous non-pest species through inclusion of features like islands and an irregular, thickly vegetated shoreline. Care should be taken to not provide extensive habitat elements favored by Canada geese. Canada goose populations have become a source of reduced water quality in some areas, due to nutrient and bacteria rich fecal material and destruction of shoreline vegetation.

Ponds must also be constructed so that they are watertight and do not leak. Stormwater runoff from the course should be directed through constructed pond/wetland filtration systems, filter strips, or riparian forest buffers before flowing into existing off site water bodies.

When a course is part of a residential development, stormwater management ponds that are part of the course can be used to collect and treat runoff from impervious areas. In many cases, stormwater management features are used to collect and recycle water for irrigation and equipment washdown use, which can greatly reduce the need for other water sources.

Irrigation Water Considerations

The issue of irrigation water is a critical one. The availability of water, irrigation requirements of the golf course, and methods of application will influence the location and design of the golf course. In some areas where water supply is strictly controlled, the course design should allow for reduced irrigation requirements through use of native warm season grasses and drought-tolerant grasses in rough areas.

Irrigation issues are addressed in the design phase. Research can be done to determine if the withdrawal of groundwater for irrigation will affect the water supply of an area. Based on this research, irrigation requirements can be altered if necessary to prevent depletion of the aquifer. All alternatives to ground water, such as recycling of effluent or stored stormwater should be thoroughly investigated and used, if feasible.



Green and Tee Considerations

Green and tee locations and construction pose another set of considerations. Both greens and tees should be located in areas where the depth to seasonal high water table or bedrock is greater than four feet. Underdrain systems for greens and tees must also maintain four feet of soil separation between the subsurface drainage system and the water table or bedrock. Part of tee and green construction should include provisions for leachate collection and filtration.

Poorly located tees and greens can present a great environmental liability. Excessive shading and reduced airflow will decrease turfgrass vigor and increase disease pressure. This then means greater chemical use to sustain turfgrass quality. This consideration is especially critical in humid climates like New Jersey.



Vegetation Considerations

The natural vegetation of the site is assessed for habitat and water quality benefits. Evaluation is made for the extent of clearing necessary and areas for potential revegetation with native plant materials. Trees especially can be incorporated into the characteristics of the course, affecting shot making strategy and enhancing aesthetics.

Areas providing vegetative habitat for desired or protected wildlife are worked around and incorporated into the flavor of the layout. For example, roughs can provide foraging habitat for raptors feeding on small rodents. These areas should be allowed to grow to a height of 12-18 inches and kept as old field habitat. If rough is planted, utilize grass species that are relatively deep rooted and climate tolerant.

Other Course Planning Considerations

The orientation of sun and wind is another consideration. Longer holes can be situated to take advantage of wind direction and are not adversely impacted with rising or setting sun.

The existing road system should be evaluated to determine points of access to provide the most efficient ingress, egress, and local circulation for golf course operations.

Buildings and Parking Considerations

The construction of clubhouses, pro shops, food & beverage facilities, parking lots, and maintenance areas causes water quality impacts similar to traditional commercial development. Runoff from these areas can contribute sediment, heavy metals, fecal bacteria, organic and inorganic debris, household chemicals, oils & greases, and floatables to the adjacent surface waters. Since most of these facilities require extensive impervious surfaces, stormwater runoff volumes are much heavier than pre-development conditions. The impacts of higher pollutant export are felt not only in adjacent water bodies, but also far downstream.

Impervious areas should always be kept to a minimum. Parking lots, especially, can be installed so that paved parking exists for only the year round daily 'average' number of vehicles rather than the maximum possible. Overflow parking for weekends and other busy times should be on porous gravel, to reduce runoff. Runoff management practices such as infiltration trenches, sand filters, and/or catch basins

enhanced with filtration or settling capability should be planned and installed in the most advantageous locations.



Summary

Remember, it is in the planning and design phase that responsible solutions are found for the environmental issues. Impacts during construction and management of the course can best be avoided by identifying and addressing all potential environmental issues beforehand. To provide the proper environmental protection during construction, the location of erosion and stormwater management controls must be included as part of the original plan.

Inclusion and consideration of all of these factors will result in a plan that can be passed and permitted more readily.

Construction Phase

Once the planning and design process has been completed and a satisfactory plan has been reviewed and permitted, the construction phase is initiated. The construction requirements will typically include:

- Soil Erosion and Sediment Control Plan: This Plan is developed in accordance with the Standards for Soil Erosion and Sediment Control in NJ, which are administered by the NJ Dept. of Agriculture, State Soil Conservation Committee, and enforced by the local Soil Conservation District. The Plan is required for the project to be approved for construction. The Plan shows the location and methods of controls for stormwater and erosion on disturbed areas of the site during construction.
- Grading and Drainage Plan: This shows the overall plan for construction of the golf course and the terrain alteration necessary to create course features and produce proper drainage. Both pre and post construction contours should be shown.
- Clearing Plan: Indicates the limits of clearing necessary for construction of the golf course. Specimen trees to be saved or areas of natural vegetation to be preserved will be shown here and staked in the field.
- Staking plan: Locates the key points (greens, tees, fairways) and no-disturbance areas in the field for review and construction.

- Tee and Green Plans: Provides details for the construction of each tee and green complex.
- Vegetation Plan: Indicates the areas where specific turfgrasses and in some cases, ornamental grasses and trees are to be planted. Species for fairways, tees, and greens should be consistent with Rutgers Cooperative Extension turf recommendations. As a part of this plan, the conservation and natural areas are included.
- Irrigation Plan: This provides all information for the type of irrigation system, pump locations, and conduit network to be installed.
- Construction Details: Shows how the golf course features (greens, tees, bunkers, ponds) are to be constructed in detail.
- Specification and Bid Documents: Outlines the methods, materials, and details of construction for course completion.

Regulatory Note

All golf course design, construction and operations are under the jurisdiction of the same land use regulations as any projects administered by NJ DEP Land Use Regulation Program (LUR).

This includes, but is not limited to:

coastal environments, wetlands, and floodplains. Non-game and endangered species are protected under the Endangered and Nongame Species Program, NJ Division of Fish & Game.



As mentioned earlier, the golf course superintendent should be hired prior to the start of construction. The superintendent will serve as the onsite representative for the owner and be responsible for checking on the site on a daily basis.

During construction, site visits are also made by the course architect and the consultant team to ensure that the goals of the course will be met. Inspections are also made by Soil Conservation District and NJDEP officials and local officials to monitor the erosion control and other environmental quality measures.

The Construction Process

The construction process starts with the stakeout of the golf course by the consulting engineer. After the key points and centerlines of each golf hole have been staked in the field, the golf course architect

reviews their relationship to the site's characteristics. Minor field adjustments are made at that time to best fit the course features into the landscape and preserve unique natural features such as rock outcrops or large trees.

The soil erosion and sediment control features are then installed and checked to ensure proper placement and installation prior to the clearing and grading of the site. Sediment loading from large construction sites may be as much as *100 times* greater per acre than farmed fields. Suspended solids represent not only an important pollutant, but are also a principal transport vector for other surface water pollutants such as phosphorous fertilizer, pesticides, and heavy metals. Golf course construction often involves the disturbance of an unusually large amount of land. Unless runoff is properly managed during construction, increased erosion and sedimentation, increased water turbidity, decreased aquatic productivity, and reduced water quality will result.

The Standards for Soil Erosion and Sediment Control in NJ provide descriptions and design criteria for the most effective soil conservation. Practices such as staged sequence of construction, silt fence, sediment basin, diversion, mulching, conduit outlet protection, temporary stabilization, and others will be needed throughout the course. These controls are placed to control erosion during clearing and grading with extra emphasis on sensitive slopes, habitats, and especially all ponds, streams, and wetlands. The measures are in place throughout construction until all disturbed areas are vegetated and stabilized. Some will remain as permanent water management features of the course.

Clearing of the site then begins, with special care given to areas containing trees. All tree removal is done in phases to prevent damage to preserved trees and integrate tree communities into the fabric of the course. Trees are one of the best ways to create compatibility between the golf course and the site, incorporating a natural setting into the golfing strategy.

Addressing Soil Compaction

Parking lots, cart paths and maintenance roads are laid down with subbase and then used as the primary staging and pathway for construction equipment in order to reduce soil compaction and damage to vegetation.

The issue of preventing soil compaction is a critical one. The natural infiltration capacity of the soil before disturbance is started is an important stormwater management component. Post-construction soil quality should be managed so as to stay as close as possible to the pre-construction condition.

If good soil quality is preserved in the construction process, future dividends of reduced maintenance will be realized. Specifically, there will be a reduction of plant stress from poor drainage and root restrictions. This in turn will mean less disease risk. A healthy plant is a lower maintenance plant.

Some soil quality concepts are:

- Preserve and stay off of as much of the site as possible, especially woods
- Use the lightest-weight construction and maintenance equipment possible
- Avoid doing grading and earthmoving when the soil is saturated
- Loosen the top 12-18 inches of soil after grading, before seeding
- Incorporate organic matter like leaf compost in the top 12-18 inches
- Avoid rolling established greens when saturated.

After primary path establishment, the golf course is then cleared and graded as efficiently as possible to avoid excessive disturbance, minimize soil compaction, provide proper drainage, and set up the course features. First, the site is rough graded to accomplish the major earthwork necessary for the essential earth and water features. Fine grading is then done to smoothly blend features together. As a part of this operation, the topsoil is removed, stockpiled and stabilized for replacement after final grading.

Final Steps

After grading, the irrigation system is installed. The system must be up and running in order to support the seeding of the course.

Next, all disturbed areas are prepared and planted with the specific types of turf grass or other grasses specified in the vegetation plan. All areas will need mulching for protection during germination and seedling stage.

(Much of Chapter One adapted from:

Love, William R. An Environmental Approach to Golf Course Development. American Society of Golf Course Architects, Chicago, IL 1999)



The landscaping of the course will be done at this point, with trees, shrubs, and ornamentals placed to enhance the sporting, aesthetic, and environmental qualities of the course. Conservation areas can be enhanced with native grasses for improved habitat and visually interesting rough areas. Nest boxes, birdhouses, and bat houses can be installed in this phase. Encouraging species such as swallows, bluebirds, wood ducks, barn owls, and bats will also reduce gnat and mosquito problems.

Prior to the completion of construction, the maintenance and management of the golf course will start. During the vegetative establishment period, responsible management practices are monitored and maintained and the golf course is prepared for opening. After all disturbed areas are completely stable and vegetated, the temporary erosion controls will be removed. Permanent structures will be cleaned out and enhanced vegetatively to fill the role of permanent course stormwater feature.